Bashkirian Mudstones, Implications for Shale Gas Source Rock Development

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In sedimentary basins of Western Europe and along the western margin of the Appalachian mountains in the USA, there are significant thicknesses of siliciclastic mudstones with subordinate sandstones of Latest Mississippian to Pennsylvanian age. Strata of this age are well exposed in the UK and Ireland and are age-equivalents of US shale gas plays, such as the Barnett Shale in the lower Mississippian of Central Texas US.

The study examines the spatial variability from a stratigraphically well-constrained Bashkirian mudstone succession. A key Bashkirian maximum flooding surface and overlying highstand sediments are exposed across a large area of a UK Carboniferous basin (the Pennine Basin) and samples have been collected across this marker unit from a number of locations. Field and hand specimen analysis with whole rock geochemical (including XRF, XRD and Carbon/Sulphur analysis), paleontological and detailed petrographic data are used to undertake this high-resolution study.

This study will contribute to our understanding by exploring the character of these mudstones and will address (1) the key mechanisms transporting and depositing fine-grained sediment on to marine shelves (2) examine the controls on the type and amount of organic matter preserved and (3) determine the controls on spatial variations in organic matter type and abundance.

These mudstones contain significant amounts of organic matter, TOC values vary from 0% to 9.4%. This is primarily terrestrial organic matter including plant debris and microscopic spores. 5% to 9.4% TOC values are found in the maximum flooding surfaces, with 0% to 4.6% found in the surrounding mudstones. Elements from the water column, such as As, Mo, U and V have higher abundances (up to 174.7, 205, 25.1 and 1163ppm respectively) when the detrital input is lower and so correspond with lower abundances of Zr (91.7-121.4ppm). As a result the succession has been grouped based on the geochemical variations.

The results demonstrate that facies changes relate to the physical sediment transport processes delivering and dispersing sediment at different locations within the basin and to variations in primary production within the basin. Post-depositional sediment disruption caused variously by infaunal colonization and diagenetic processes is also recognised.